

Density Estimates by Habitats for the Southeastern Painted Bunting Breeding Population: A comparison of detection distance, song playback, and fixed-radius sampling methods



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Abstract: Based on annual Breeding Bird Survey population trends, the southeastern U.S. population of the Painted Bunting (PABU) has declined ca. 3.2% per year since 1966. This "species at risk" of endangerment, however, has not been surveyed in its major breeding habitats in the Lower Coastal Plain from North Carolina to Florida. We conducted 5-min point counts and 2-min PABU song playback counts using a laser rangefinder and compass (1 m and 1 degree accuracy) to estimate the distance and bearing from the observer to singing males (SM). We randomly selected study sites within habitats with an emphasis of the major habitats (i.e., shrub-scrub, maritime oak, young pine, open saw-timber, and developed). No differences were found between observers' effective radial distance (62 and 74 m, $P > 0.05$) for distance point counts. We selected a half-normal/cosine distance sampling model based on the lowest AIC scores. We detected SM PABUs on 43.2% of the point counts ($n = 590$). Overall density for the study was 23.3 SM/km² (90% CI: 19.8 to 27.4, CV = 7.0%) with an effective radial detection distance of 70 m. We detected our highest density, 30.5 SM/km² (90% CI: 23.3 to 40.1) in shrub-scrub habitat, which was higher than our lowest density estimate of 8.8 SM/km² (90% CI: 4.3 to 18.0) in young pine plantations. In other undeveloped habitats, density estimates were similar: maritime oak (24.3 SM/km², 90% CI: 17.6 to 33.5), shrub-scrub in agriculture (21.6 SM/km², 90% CI: 10.6 to 44.1), and open pine saw-timber (14.8 SM/km², 90% CI: 7.9 to 27.5). Similar habitat in developed and undeveloped sites had similar PABU density estimates: undeveloped (27.8 SM/km², 90% CI: 22.9 to 33.7) and developed (16.5 SM/km², 90% CI: 8.0 to 34.0). Fixed-radius (70 m) sampling underestimated the density of PABUs by 4.8 to 11.7 SM/km² with the exception of young pine plantations, which were similar to distance sampling (8.8 for distance estimates to 8.5 SM/km² in 70-m radius circle). Song playback sampling (2 min added to 5-min point counts) density estimates in 70 m fixed-radius circles were almost identical when compared to distance sampling estimates for shrub-scrub (+1.8 SM/km²), maritime oak (+0.1 SM/km²), undeveloped (-0.4 SM/km²), and shrub-scrub agriculture (-4.0 SM/km²) habitats. Song playback sampling overestimated densities for young pine plantations and developed land compared to distance sampling from +4.6 to +12.0 SM/km², respectively. To maintain PABU populations in the southeastern U.S., we recommend that managers conserve all shrub-scrub, maritime oak, and open older pine forests, especially near beaches and marshes. We do not recommend using young pine plantations for habitat management of PABUs. Future research should determine not only if a potential PABU density reduction exists in developed land, but also determine if this habitat has PABU reproductive success (nesting success) that is sufficient to maintain or increase the population in the southeastern U.S. This is especially important since developed land has increased from 4 to 8% of the area in the coastal regions of Georgia and South Carolina during the last 30 years.



Fig. 1. Singing Male (SM) Painted Bunting.

OBJECTIVE: to determine density estimates for singing male Painted Buntings in shrub-scrub, maritime oak, open saw-timber pine, young pine (plantation), shrub-scrub agricultural, and developed habitats.

STUDY AREA: Coastal North Carolina south to coastal Florida (see below; area in red for these states).

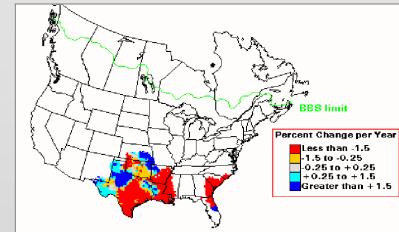


Fig. 2. Painted Bunting population trends and breeding range based on the Breeding Bird Survey (BBS) 1966-1999. Sauer et al. 2003 (www.pwrc.nbs.gov). A majority of the sites, 80% ($n = 45$) and survey points, 77% ($n = 590$) were in Georgia and South Carolina where the majority of breeding habitat and PABUs are found in the southeastern U.S.

METHODS:

- We located all potential habitats by states (especially public lands) and randomly selected sites to sample; maritime oak sites were rare and all sites located were sampled.
- Observers sampled 15 or more point counts at each site from sunrise to 4.5 hrs after sunrise. Minimum distance between points = 250 m.
- We identified all singing male (SM) Painted Buntings (PABU) and recorded distance from observer to SM using a laser rangefinder (± 1 m) and determined the bearings using a compass (mapped birds) during a 5-min period sampling period.
- After first 5-min, we played a 30 sec taped PABU song with a recorder and amplified speakers (2.5 cm, Radio Shack) at a volume that humans could hear at least 100 m from source.
- We analyzed data and determined SM density/km² using PROGRAM DISTANCE 4.0 (Buckland et al. 1993) for each habitat type.
- We used the effective radial distance, 70 m (from PROGRAM DISTANCE analysis), to determine the density of SMs in 70 m fixed radius circular counts for the first 5-min.
- We also used the effective radial distance, 70 m (from PROGRAM DISTANCE analysis), to determine the density of SMs in 70 m fixed radius circular counts during the total 7-min sampling period, which included song playback.

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RESULTS:

Distance Model Selected: Half Normal/Cosine based on lowest AIC scores. Coefficient of Variation for model = 7.0% for all data.

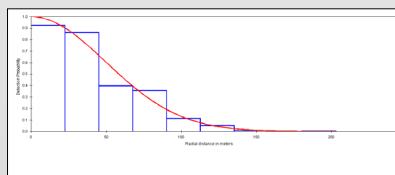


Fig. 3. Detection function (red) and histogram (blue) of observed detection distances for the selected half normal/cosine model of the Painted Bunting density estimate for ($n = 209$, 590 point counts) the southeastern U.S., 2003.

DETECTION DISTANCE SAMPLING:

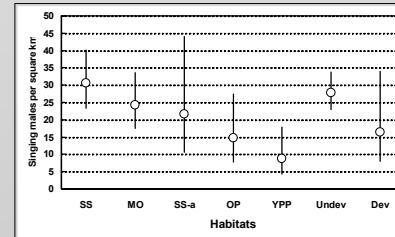


Fig. 4. PABU SM densities (distance sampling) and 90% confidence intervals (vertical lines) by habitats for the southeastern U.S., 2003.
Habitats: SS = shrub-scrub, MO = maritime oak, SS-a = shrub-scrub in agriculture, OP = open pine (saw-timber), YPP = young pine plantations (1-4 yrs old); Undev = undeveloped land in SS, MO, and OP habitat; Dev = developed land in SS, MO, and OP habitat.

- We detected our highest density, 30.5 SM/km² (90% CI: 23.3 to 40.1) in shrub-scrub habitat, which was higher than our lowest density estimate of 8.8 SM/km² (90% CI: 4.3 to 18.0) in young pine plantations (Fig. 4).
- Similar habitat in developed and undeveloped sites had similar PABU density estimates: undeveloped (27.8, 90% CI: 22.9 to 33.7) and developed (16.5 SM/km², 90% CI: 8.0 to 34.0) (Fig. 4).
- Low sample sizes for developed and undeveloped for most major habitats prevented testing by habitat types.
- In other undeveloped habitats, densities estimates were similar: maritime oak (24.3 SM/km², 90% CI: 17.6 to 33.5), shrub-scrub in agriculture (21.6 SM/km², 90% CI: 10.6 to 44.1), and open pine saw-timber (14.8 SM/km², 90% CI: 7.9 to 27.5) (Fig. 4).

Acknowledgements: USFWS provided partial funding. We thank NC, SC, GA, and FL state parks, USFWS Region 4 Refuges, and the National Park Service for access to survey areas and for logistical support.

FIXED RADIUS SAMPLING:

- Using the effective radial distance of 70 m (distance sampling) for a 70-m fixed distance circular plot, we found that fixed-radius sampling underestimated the density of PABUs by 4.8 to 11.7 SM/km² with the exception of young pine plantations, which were similar to distance sampling (8.8 for distance estimates compared to 8.5 SM/km² in 70-m fixed radius circles) (Figs. 4 and 5).

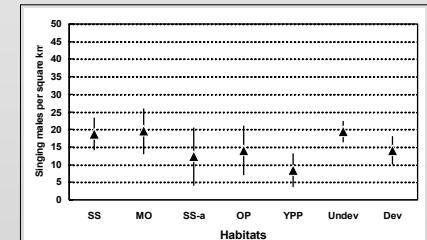


Fig. 5. PABU SM densities (70 m fixed radius) and 90% confidence intervals (vertical lines) by habitats for the southeastern U.S., 2003 (see Fig. 4 for codes).

FIXED RADIUS SAMPLING with SONG PLAYBACK:

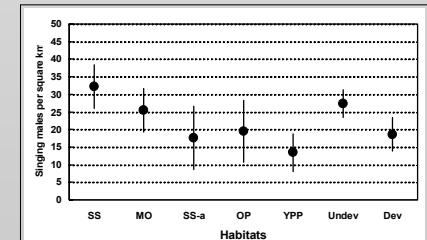


Fig. 6. PABU SM densities (70 m fixed radius with song playback) and 90% confidence intervals (vertical lines) by habitats for the southeastern U.S., 2003 (see Fig. 4 for codes).

- Song playback sampling (2 min added to 5-min point counts) density estimates in 70 m fixed-radius circles (Fig. 6) were almost identical when compared to distance sampling estimates (Fig. 4) for shrub-scrub (+1.8 SM/km²), maritime oak (+0.1 SM/km²), undeveloped (-0.4 SM/km²), and shrub-scrub agriculture (-4.0 SM/km²) habitats.

DISCUSSION AND MANAGEMENT IMPLICATIONS:

- Conserve all shrub-scrub, maritime oak, and older open pine forests, especially near beaches and marshes, for PABU breeding habitat.
- Do not use young pine plantations for PABU habitat management.
- Density estimates for SS (30.5 SM/km²) and OP (14.8 SM/km²) habitat in the SE U.S. during 2003 were identical to densities determined from radio telemetry of non-overlapping PABU home ranges ($n = 45$) on Sapelo Island, 1997-1998 (Springborn 1999).